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# Recommendations for maximizing the benefits of the vernal pool at Miller Ecological Park

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## **Executive Summary**

The Will and Harriet Miller Ecological Park is a 46-acre passive recreational use park located in Lebanon, Ohio that was recently awarded the Clean Ohio Grant for an amount of \$551,000. The award was used to purchase an additional 51 acres, which will be used as a preservation area. The Miller Ecological Park (MEP) Steering committee has turned to our group to provide a blueprint for developing the newly acquired parcel. The land consists of four distinct areas, one of which may be a vernal pool. A vernal pool is a wetland that holds water seasonally and is very active in terms of biodiversity. Due to the increasing rarity of this ecosystem, along with its biodiversity, we recommend that it should be the focal point of the land's development. In order to cover the range of issues that may arise, we have focused on the environmental, social, and economic benefits and challenges the vernal pool may present.

The main environmental obstacle present is that the board must determine if the vernal pool is actually a vernal pool, or if it is simply a product of the soybean field that lies in the adjacent land. Vernal pools can be created by runoff from agriculture, so the land's classification as a vernal pool may be in danger once the soybean field is restored into either a wet prairie or wetland. Additionally, the board must conduct species surveys to establish an ongoing knowledge bank of the flora and fauna present in the area. Finally, the invasive species at MEP, which are abundant throughout the park, must be eradicated.

As a social benefit, MEP has expressed a great interest in using the vernal pool as an educational tool for the community. In order to maximize the educational opportunities, we recommend that boardwalks and educational tools such as signs and brochures be constructed throughout the park.

The restoration of the vernal pool will allow MEP to receive economic benefits. In order to complete the projects on hand, the park must find volunteers. Volunteers will assist in lowering the cost of park projects, and will incorporate community involvement at MEP. In addition to creating pride in the community, the biodiversity and rarity of the vernal pool will allow the park to stand out among grant applicants and potentially earn the park additional funding.

Focusing on the vernal pool is a unique opportunity that the Miller Ecological Park can use to set itself apart from other parks. With such a unique ecosystem, the park can gain notoriety around the area and increase the number of visitors that come to the park. Should the

vernal pool be successfully restored, the park will become a model for wetland restoration around the state and country.

### Introduction

This past year, the City of Lebanon was able to purchase an additional 51 acres, as shown in Figure 1, through an award from the Clean Ohio Grant expanding the Miller Ecological park acreage to 96 acres (Will and Harriet Miller Ecological Park, 2013). After discussion with members of the Miller Ecological Park (MEP) Steering committee, we have chosen to focus our research on a vernal pool inside the newly acquired acreage. Our research covers methods of invasive species removal, reintroduction of native species, and the opportunity to build a boardwalk on the wetlands, which are areas of specific interest to the MEP Steering committee (Huitger, 2013). In addition, our recommendations address problems that may arise. Since vernal pools fluctuate seasonally and are hotbeds for biodiversity, an understanding of whether or not the vernal pool is self-sustaining and independent of other temporary factors is a necessary step before any plans can be implemented at the park. The intention of this paper is to provide the necessary steps needed to determine the health and self-sustaining qualities of the vernal pool.

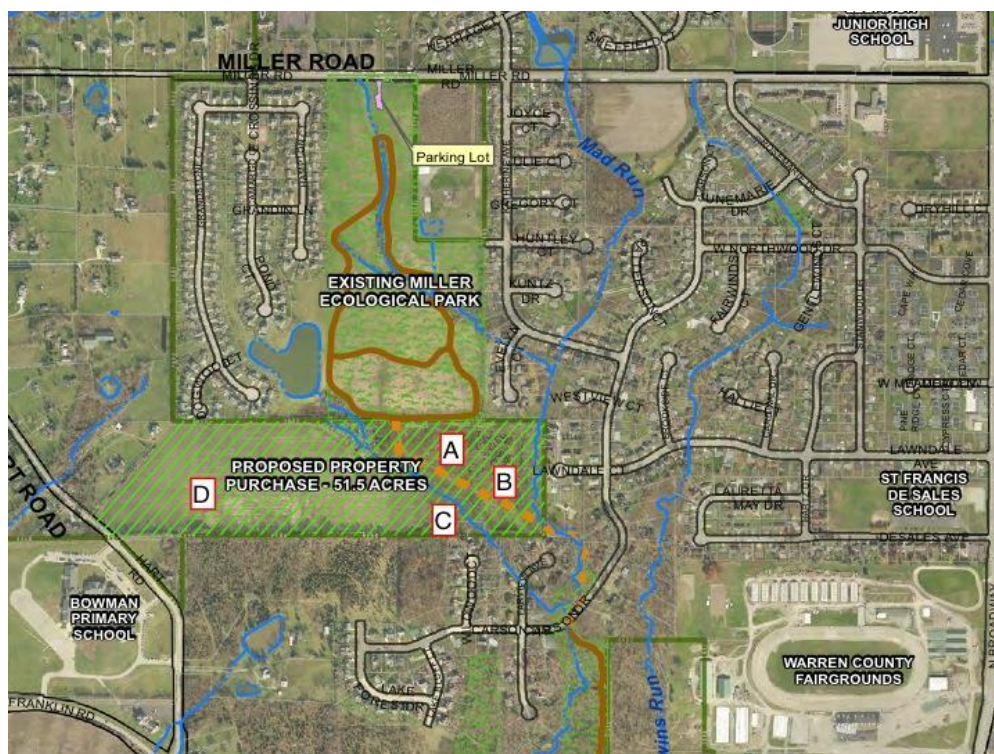


Figure 1. This map shows the previously existing MEP boundaries, as well as the newly acquired parcel marked by green diagonal lines. (<http://www.millerecopark.org/>)

Based on the potential results, we will follow up by providing the MEP Committee with a toolbox of what we believe to be the best options for the area. Maximizing the economic, social, and environmental benefits of the vernal pool will help establish the Will and Harriet Miller Park as a model for other ecological parks across the nation.

Over the past few centuries, Ohio has lost over 90 percent of its original wetlands from urban and agricultural development (“Ohio’s Hidden Wonders: A Guide to the Animals & Plants of Ohio’s Vernal Pools,” 2005). Vernal pools are considered to have some of the highest biodiversity of any wetland classification; however they are rapidly declining in Ohio. These areas add value to the ecosystem by providing water filtration and unique habitats for threatened and endangered species. It is for these reasons that we believe MEP should focus on site C of their newly acquired land. Heather Lacey, an ecologist on the Steering committee, found that site C could potentially be classified as a Category-3 wetland (Lacey, 2013). The Ohio Administrative Code states that a Category-3 wetland provides a superior habitat with high levels of diversity, a high proportion of native species, and provides habitat for threatened or endangered species (“3745-1-54 Wetland antidegradation,” 2012). Vernal pools are ephemeral, which means that they only hold water seasonally, usually from late winter into early summer. Figure 2 was taken in August of 2013 at MEP, and shows how vernal pools look during the dry season. The seasonal water patterns prevent fish from surviving, allowing a wide variety of amphibians, insects, and invertebrates to flourish. Besides the unique wildlife habitat of a vernal pool, these ecosystems can help reduce runoff, attract mosquito-eating animals, and provide educational opportunities (“How To: Build a Vernal Pond,” 2008).

### **Environmental**

The newly acquired land contains four different areas labeled site A, B, C, and D, which can be seen in Figure 1. Sites A and B are considered to potentially be Category-2 wetlands, which support moderate wildlife habitat (Lacey, 2013). Site D was not considered to be a wetland area, and while it is currently a soybean crop field, it has potential to be converted back into a prairie and grassland. It is important to note that the soybean field is located directly west of the vernal pool, as seen in Figure 3, with the topography suggesting a substantial amount of runoff going directly to the vernal pool and adjacent stream. A study should be conducted in order to determine the exact topography of site C as well as the surrounding sites, to determine





*Figure 2.* This photo was taken during the dry season of the potential vernal pool at MEP. It is possible to see an algae ring from when there was standing water. (Photo taken by Kori Goldberg)



*Figure 3.* This photo is taken from the view point of the vernal pool looking out at the adjacent soybean field. It is possible to see that the field is sloping downward toward the vernal pool. (Photo taken by Kori Goldberg)

what percent of the vernal pool hydrology is provided by runoff compared to groundwater. A study should also be done to monitor the site for a year. During this period, water levels should be recorded, water and soil nutrient levels should be tested, and a survey of plant and animal species should be conducted. These studies will reveal how self-sustaining the vernal pool area is and will help determine if it would be more beneficial to excavate the area further to enhance the habitat, or to let it remain as is.

If the vernal pool is not self-sustaining, or if it is dependent upon runoff from the soybean field, we suggest that the area be restored as a forested wetland instead of a vernal pool. The board should consider how the restoration of site D will affect site C, since these two sites are substantially linked. Vernal pools thrive in a combination of sun and shade, providing habitat for woodland frogs and salamanders as well as flowering plants. If site D is restored back into prairie land, this will benefit the vernal pool by providing some sunlight. It will also provide the least amount of impact to the amount of runoff that supplies the vernal pool, as prairies generally do not yield the high hydraulic retention rates that other wetlands or forested riparian buffers do. The soil survey completed by the United States Department of Agriculture shows that the vernal pool has Dana silt loam with 2.0 to 6.0 percent slopes, and Wynn silt loam with 2.0 to 6.0 percent slopes. These soil types are conducive to holding water for extended periods of time, so the area appears to be suitable. It is recommended that there should be a vegetative buffer to prevent sediments from filling in the area any further (Biebighauser, n.d.).

### **Species Surveys- Plant and Animal**

Species surveys are used to determine what types of flora or fauna are present in any given area. These surveys are crucial and will be pivotal to MEP by providing useful information to the public, assisting in monitoring the development of the park, and discovering the growth rates of a given species. Surveys should be performed annually in order to maintain records and should be recorded categorically by mammals, amphibians, birds, and plants. It is possible to recruit volunteers to survey wetland ecosystems and conduct tests to determine which types of species are present.

The process of surveying amphibians is somewhat different than surveying other species. Researchers conduct these surveys primarily with funnel traps three times a year, starting as early as mid-February to catch breeding adults entering the pools. The majority of frog, toad, and salamander species are nocturnal, so it is recommended that the surveying should be completed

both day and at night. In a recent study, traps were left for 24 hours so both diurnal and nocturnal species could be thoroughly recorded (Korfel, 2010). It was noted in the study that larvae numbers significantly decreased over the course of the month of June to the month of July. This decrease is attributed to the absence of predators as well as natural selection. Additionally, it is typical that larvae and tadpoles do not survive after July. When volunteers or professionals are collecting samples, it is helpful to have an identification book handy in order to reference various species.

Many mammals such as shrews, star-nosed moles, beavers, mink, otters, and various species of mice can be found in and around wetlands as well. Pictures and guidebooks will help lead to identification of these specific species and assist the park in conducting a thorough survey. A great resource for this is *Wetland Mammals* provided by the Wildlife Habitat Management Institute, information for which can be found in section F of Table 1 (May, 2001). Similar to amphibians, some mammals are nocturnal, and surveys should be performed at various points throughout a 24-hour day. Surveyors should be trained to identify indicators, which can help reveal the certain types of mammals that are present. For instance, an indication that beavers are present is the teeth marks the rodent leaves in trees and saplings. It is important for surveyors to be familiar with the subtle differences between indicators because animals, such as muskrats and mice, have similar but distinctive burrowing patterns.

Birds and waterfowl should also be considered when evaluating wildlife in a wetland. Due to their migratory patterns, surveys should be conducted periodically throughout the year and encompass all four seasons. This will lead to better surveys of birds and waterfowl that inhabit an area. The use of volunteers for this type of surveying would be beneficial as they often excel at bird watching and can easily identify bird species with the aid of reference books.

In addition to animal species, it is equally important to survey plant species. Wetland ecosystems are composed of an assortment of plant species; some of which are native, rare, or invasive. Vernal pools, including the potential one found within the Miller Ecological Park, typically contain trees that shelter the wetland itself. Wetlands contain several plant species and one should use a reference guide, such as one found in section G of Table 1, when identifying them (Cox, 2002). Surveys should be repeated annually in order to keep records up to date. Species surveys help to identify animals and monitor the health of the Miller Ecological Park.





*Figure 4.* These photos are examples of a few of the invasive species present in the park, and were taken during the group's trip to MEP in September 2013. (Photos taken by Kori Goldberg)

### **Invasive Species Removal**

Invasive plants are difficult to control due to their resilience and ability to quickly develop in a region. During a visit to the Miller Ecological Park, it was discovered that the recently acquired 51-acre preserve is overgrown with many invasive plants, which is negatively affecting the environmental benefits of the space (Figure 4). The eradication of invasive plant species is necessary in order for the park and community to benefit from the land. While the City of Lebanon has already commenced the eradication process by marking pockets of individual invasive plant species along with the use of herbicides, there are other options they can consider to aid in removing the rest of them.

Invasive plant species can be combated in a variety of ways that are dependent on the species being targeted. Depending upon available financial and labor resources, certain methods will prove to be more beneficial than others. Through extensive research, three removal methods have proven to be potential solutions. The first method is mechanical control, which would

involve the use of equipment, such as “bush hogs,” to clear the land. A bush hog is a large machine that clears small shrubs and foliage. This option could potentially become fairly expensive, however, as a standard rate for a walk behind “bush hog” machine from suppliers in the region is approximately \$965.00 per month. In many cases it is found that these companies offer discounts or even free rentals to non-profitable companies and organizations. It is recommended the MEP Steering Committee research this to see which companies would be willing to help. In a situation where the committee is unable to find a machine at a reasonable price point, the park may be able to acquire one through the City of Lebanon.

The second method for removing invasive species would be chemical control. While this is the most effective control method, it could also be the most expensive due to high costs of the chemicals and the permits needed to obtain and use them. MEP would need to apply for a National Pollutant Discharge Elimination System (NPDES) General Permit for Pesticide Application. The NPDES permit is required for the discharge of chemicals near water, or in this case, sensitive water locations, which would include the wetlands on site. The cost of this permit is \$200.00 and can be applied for online at the Ohio EPA’s website. Information, including a helpful fact sheet and step-by-step information on how to apply for this required permit, can be found in Section H of Table 1. Once these permits have been issued, the park may apply pesticides. Glyphosate is an effective pesticide that has been approved for dispersal in wetland regions, and is a common choice for parks as it is non-toxic to birds, fish, and mammals. Measurements of the area in need of being cleared of invasive species would need to be taken, so the amount of necessary product can be determined. It is not required that the chemicals be applied by qualified individuals. If volunteers are recruited, they would be able to apply these chemicals on the plants by either spraying, or wiping the chemical compound onto the leaves.

The final method for removal of these invasive plants is a physical approach. This is the most time consuming method, due to the fact that the plants would have to be removed by hand. While this will be costly due to the purchase of tools to remove these plants, it is the least expensive option available. Should the committee decide to pursue this method, we recommend that the amount of time required to remove the high density of invasive plants be taken into account. The time frame for this solution is dependent on the number of volunteers that are recruited to complete the removal projects.

## **Social**

### **Boardwalks and Walking Trails**

As the Miller Ecological Park develops the newly acquired preserve, the issue of accessibility will present itself. The area is currently covered in brush and invasive species, making it difficult to navigate to and through the vernal pool area. In order to mitigate this issue, MEP must construct boardwalks and walking trails. Boardwalks are a useful tool for the visitors of a park, as they provide access to the public to allow better views of the wetlands. Unlike ordinary walking trails, boardwalks reduce human impact, as people will never have to walk on the physical ground. This reduces human contact with the native flora and fauna, some of which might be sensitive to human interaction. However, there is a potential for damage to the boardwalks that would stem from weather concerns such as flooding and ice. Additionally, the material used for boardwalks could pollute water, especially in the case of pressure treated wood. There are substitutes available to pressure treated wood, but they would be more costly. Finally, MEP would need to assemble enough volunteers to build the boardwalk to ease the cost of construction and labor. If MEP enjoys the results of a boardwalk, they could also choose to expand it and possibly add viewing platforms that would give visitors a “birds-eye view” of the vernal pool and wetlands. More information on the construction of boardwalks and their benefits can be found in Section I of Table 1.

### **Education- Signs and Pamphlets for Observers**

As the Miller Ecological Park solves the problem of accessibility by completing the boardwalks and walking trails, the question of how they will be used will arise. In addition to providing an elevated walkway for visitors, the boardwalks could serve as an educational tool providing brochures and signage along the pathways.

Brochures can enhance a visitor’s experience to the park by providing important information that gives the reader background knowledge on the site. Overall, “a brochure should briefly describe the wetland including its history and why it is important” (Kusler, n.d.). MEP could include historical information on the original owners of the land, as well as details on the newly acquired preserve. Additionally, a brochure can relay rules, maps, and points of interest for local areas to visitors who may be unfamiliar to the park. Points of interest within the Miller Ecological Park include the newly acquired vernal pool. Vernal pools serve as unique wetland

areas that attract a wide variety of species not commonly found in Ohio such as fairy shrimp, water snakes, and various types of salamanders. Since the vernal pool is the centerpiece of the new land, brochures should highlight its benefits and other facts. Finally, wetland brochures should follow a simple outline that helps to inform the public (Department of Conservation, 2010). Educating the public through the use of brochures provides the opportunity to create interesting facts and fun opportunities that can affect members of all age groups.

Signs can also assist in educating groups of people, especially those who are young students or walkers. Signs should be used to point out key points of a wetland ecosystem, as well as educate the public on a variety of subjects. These subjects can range anywhere from the species that live in a wetland area to facts about water quality and the importance of wetlands for society. The construction of the signs should be simple and weather resistant, placed at a distance of about three feet away from the boardwalk to reduce the potential for casual vandalism. Additionally, the placement of a sign should be in a visible area that does not distract visitors from the viewpoint of an attraction. Signs help to keep visitors interested in wetlands and they also help to establish what the viewer is looking at when they are observing a wetland.

### **Pets- Impact on Wetlands**

Pets are a controversial discussion point when considering issues pertaining to human impacts on parks and the atmosphere they create. While many people enjoy bringing their dogs to parks, others view them as nuisances. Certain metro parks have placed a ban on dogs within park boundaries due to the harm they can inflict on an ecosystem. This ban is often for the protection and well being of native plant species. Dogs that are not monitored tend to dig at plants and create disturbances within an environment. Additionally, it is crucial that wild animals have minimal interaction with dogs. When wildlife come in contact with dogs, they may become disturbed and be scared out of the park in the process. This is problematic for both park visitors and native animal species, as many people visit parks in order to view wildlife. If the wildlife is disturbed and frightened away from the park, the experience of a park visitor will diminish. MEP should strive to retain local wildlife in the park boundaries as opposed to unprotected areas or private land. Overall, dogs must be monitored closely in wetland areas because of their impact.

A solution that has been implemented in some parks is a leash policy for dogs. This solution often proves to be effective at keeping the ecosystem intact and unharmed. One specific example of a “No-dogs Policy” is at National Golden Gate Park, which recently decided to ban

dogs, upsetting many people who regularly visited the park with their pets. This decision resulted in reduced park attendance. The decision to ban dogs served as a tool to preserve the ecosystem, but, as one report noted, “While you might think neighbors would be thrilled to see this scenic landscape preserved, the relationship between the National Park Service and locals is off to a rocky start” (Standen, 2012). When considering if the Miller Ecological Park should allow pets, the committee should weigh the natural disturbances that dogs induce as well as the negative or positive responses from the public. The public may resist the idea of a domestic animal ban; however, allowing dogs may mean sacrificing the integrity of the plant life and wildlife at the park. Overall, both the viewpoints of wetland advocates and the community should be considered, and a leash policy or specific “No-dogs allowed” zones might be a happy medium.

Another important consideration concerning the impact of pets on parks is feral cats. The problem of feral cats is an increasingly troublesome issue in Ohio. The cats have been known to prey on local wildlife and, more specifically, birds and small mammals. This could be problematic for the Miller Ecological Park, and the committee should consider educating people around the area about feral cats and their impacts on local species.

### **Economic**

The aforementioned projects are exciting and promising, but some are associated with high costs. The soil testing and conversion of the soybean field to wetlands will require professional guidance and equipment. In addition, the removal of invasive species and the construction of low-impact walking trails will require workers who are able to conduct physical labor. The use of volunteers will be crucial to the successful development of the Miller Ecological Park. Due to limited funds, it is possible that the park will not have the money required to hire enough workers to complete all of the projects that need to be completed around the park. In order to be successful, the park must reach out to various volunteer groups and organizations. There are several service-oriented groups around the state that may be able to provide assistance in the park.

One group that could provide volunteers in the park is the Boy Scouts of America. The Boy Scouts of America is a youth organization with an objective of environmental conservation and service learning. These troops complete service projects and have experience in plant removal, building skills (which would be valuable for the construction of a boardwalk), and eradication of invasive plant species. In order to obtain the help of the Boy Scouts of America,

the park must contact the Dan Beard Council and local troops, the information of which can be found in Section A of Table 1.

In addition to volunteer groups that focus on a wide variety of projects, there are also groups around the state and country that are devoted to the preservation and restoration of vernal pool and wetland ecosystems. The Ohio Environmental Council has a webpage specifically focusing on wetlands, which contains information on how to become involved with vernal pool projects and can be found in Section J of Table 1. The webpage contains resources the committee can use to reach out to volunteers interested in vernal pool restoration, and will help maximize the number of volunteers that can work in the park on these projects.

Another resource available to the Steering committee is the Environmental Protection Agency (EPA) webpage on volunteer opportunities associated with vernal pools and wetlands, which can be found in Section K of Table 1. This webpage specifically lays out the opportunities that are present for volunteers with vernal pool and wetland projects. Opportunities for volunteers in the park include monitoring activities, health assessment, and preservation and restoration projects. The use of volunteers will bring down the high costs associated with projects that will need to be completed to improve the overall health of the wetlands and vernal pool.

There also remains the possibility that the park will be unable to obtain enough volunteers to complete the various projects that are being implemented. In these cases, the park could find itself in a situation where additional money is required. In order to successfully implement all of these exciting plans, outside sources of funding will be necessary.

Grant applications for projects at MEP have been successful in the past, making otherwise unfeasible projects possible. The park has received the Clean Ohio Grant for an amount of \$551,000, which along with matching funds, made the purchase of the additional 51 acre preserve possible. Furthermore, the City of Lebanon's EPA grant application for the porous paver parking area and rain garden provided necessary funding \$60,000 of the total \$100,000 needed to implement these plans (Will and Harriet Miller Ecological Park, 2013). The Ohio Environmental Protection Agency offers numerous grant opportunities, several of which apply to the projects we propose at the park.

The first grant available is the Surface Water Improvement Fund. This grant is available to local governments and recognized land conservancies, both of which describe the Miller



Ecological Park. This program is offered annually and provides up to \$150,000 in funding. The purpose of this grant is to support projects that improve the water quality of rivers, streams or lakes in Ohio. Wetlands are known for their ability to improve water quality by absorbing nutrients that may be in excess, such as nitrogen and phosphorus (Johnston, 2013). Carol Johnston's research, summarized in her paper *Sediment and Nutrient Retention by Freshwater Wetlands: Effects on Surface Water Quality*, combines qualitative and quantitative data to demonstrate the benefits wetlands have on surface water quality. Transforming the newly acquired land into wetlands would improve surface water quality of the streams involved in the watershed. Therefore, this grant is well suited for the plans to restore the wetlands at Miller Ecological Park. Specific information concerning this grant can be found in Section C of Table 1.

Another EPA grant that the park is eligible for is the Ohio Environmental Education Fund. The Miller Ecological Park is a contender for this grant because it is available to any local subdivision of government. The grants range from \$5,000 to \$50,000 for projects that will help educate students, teachers, and the general public. The grant requires a 10% match, but this could be covered through fundraising, sponsorships and donations. Almost one million dollars are awarded each year for this grant and application deadlines are January 15 and July 15. More information about this grant can be found through the contact in Section D of Table 1. According to the City of Lebanon, Miller Ecological Park's vision is to create "recreational and educational opportunities for the community" (City of Lebanon, Ohio, 2013). Wetlands offer a great opportunity to educate local schools and any park visitors about Ohio's native plant and animal species, the rapid disappearance of this ecosystem, and the importance of conserving it.

The restoration of the vernal pool will probably attract special attention from the EPA and improve the chances of receiving funding for the projects at the park. Vernal pools are a rare ecosystem that certain species, such as spotted salamanders and wood frogs, are completely dependent on for survival (Homan, Windmiller & Reed, 2004). The Ohio Vernal Pool Partnership describes this ecosystem as a "miniature, fascinatingly complex and fragile world," one with immense educational potential but limited public awareness. This focus should be emphasized in grant applications because it will provide previously unexplored educational and environmental opportunities at the park.

The National Fish and Wildlife Foundation (NFWF) offers the Five Star and Urban

Waters Restoration Grant Program. This is a nationwide grant opportunity focusing on the improvement of various habitats including wetlands. Improving water quality, actively engaging community in conservation practices, and creating educational opportunities for grades K-12 are some of the main priorities of the grant. The NFWF has given grants to projects from every state, totaling \$10.8 million in grant money. Although this program has not yet been confirmed for 2014, it is highly likely that the program will be available next year. The EPA's Office of Water drafted the 2014 fiscal year program guide and recommended that the grant be renewed in 2014 (United States Environmental Protection Agency, 2013). This grant has averaged an award of \$25,000, though grants can range anywhere from \$20,000 to \$50,000. This program does require a 1:1 match, but the Miller Ecological Park would be given priority for funding because organizations involved with their local community, such as MEP, are given preference. Again, more information about this grant can be acquired through the associated contact listed in Section E of Table 1.

In addition to the benefit of improving grant chances, the wetlands offer other less intuitive economic benefits to the community. The enhancement of the vernal pool may bring in more visitors from outside of Lebanon, and donations and company sponsorships could follow. In addition, Wetlands A and B “have a reasonable potential to re-establish lost wetland functions,” such as the reduction of flooding (Lacey, 2013). By collecting and holding water, wetlands reduce the risk of flooding and the economic consequences of flooding in nearby areas (Hey & Philippi, 1995). Wetlands act as sponges soaking up extra water and releasing it back to the surrounding environment over time. The ability of wetlands to reduce flooding from rapid snowmelt, heavy precipitation, and urban run-off is of economic value to people who live in areas adjacent to the park.

### **Specific Examples of Vernal Pool Benefits**

There are many examples of successful vernal pool conservation and restoration throughout Ohio. Vernal pools exist at the Stratford Ecological Center in Delaware, Highbanks Metro Park in Lewis Center, Rush Run Preserve in Preble County, and Whetstone Prairie in Columbus, to name a few. These case studies can be used to understand some of the benefits a vernal pool can bring to a community. For example, the Stratford Ecological Center has put on educational programs to teach children and their families about the diverse wildlife living in

vernal pools. An event was held where families were invited to come “one hour after sunset [to] hike to the edge of the swamp, listening for mating calls and looking for salamanders, frogs and toads” (Delaware County Events, 2013). This type of programming could be replicated at Miller Ecological Park to involve the community and inspire children to learn more about Ohio’s natural ecosystems. This specific program charged \$3 per person or \$6 per family. If Miller Ecological Park charged a small fee to run the program the money could be used for further improvements at the park. Inniswood Metro Gardens, located in Westerville, OH put on a similar program this past spring (ThisWeek, 2013). The program, titled “Metro Five-0” was put on for people 50 years or older who wanted to explore and learn about the significance of the vernal pools at the park. Again, Miller Ecological Park could organize similar programs to engage with specific groups within the community. This could bring in great economic opportunities as well as educational opportunities.

In addition to community benefits, environmental benefits of general wetland restoration are well documented. Ongoing research at The Ohio State University conducted by William Mitsch, a professor in the School of Environment and Natural Resources and Blanca Bernal, a graduate student in the same school, have analyzed data from two separate sites in Ohio. Soil samples taken from a freshwater wetland in northern Ohio and a wetland in Gahanna were tested to determine the carbon storage rates of the wetlands. Their research found that the ability of wetlands to sequester carbon is currently undervalued by policy makers (The Ohio State University, 2012). The specific sites researched by Bernal and Mitsch exemplify substantive environmental benefits that wetlands provide to society.

### **Discussion**

With such a large number of people involved in the decision making process at the Miller Ecological Park, the problem of keeping people informed is challenging. It seems that some members of the committee are unaware of certain aspects of the current projects or surveys that may have taken place. This project not only provides the park with a toolbox of the best options available, but also serves as a method of communication that will inform the entire committee of the events and decisions that need to take place. The committee should use the research that has been compiled when choosing the ideal pathway for MEP’s development.

Based on the research that has been conducted, it is recommended that the park focus on maximizing the benefits of the vernal pool. By evaluating the environmental, social, and economical concerns that pertain to the vernal pool, the park has the opportunity to develop an ecosystem that is not commonly found in Ohio. If the park is successful in re-establishing the vernal pool, new opportunities could arise in the future that could change the outlook of the park, such as new funding or an influx in visitors. In order to accommodate an increase in visitors, it is imperative that low environmental impact access be provided. The series of boardwalks and trails that are suggested will tie all of the preservation areas together so that they are compatible for both recreational and educational use (Figure 5). It is our hope that the Miller Ecological Park will become a model to future parks that are considering wetland and vernal pool rehabilitation.



*Figure 5.* This picture depicts a crude representation of how all four areas can be connected by boardwalks or trails. It is recommended that more research be done to determine the best site plan for implementation. (Photos taken from <http://www.millerecopark.org/> and manipulated by Kori Goldberg)

## **Conclusion**

As the Miller Ecological Park advances into the development stage of the newly acquired acreage, research becomes more crucial. With the infinite amount of options present when developing this land, professional evaluations become pivotal to the park's future. These evaluations will help the park proceed and overcome issues that present themselves, such as the environmental, social, and economical problems discussed in this report. These issues should be combated with the solutions given in this overview along with additional testing, such as water and nutrient level testing, and if conducted correctly, the vernal pool and wetlands can be successfully established. This entire process is dependent on research, however, and can change based on the findings. The park needs more research done in regards to the boardwalks, pet policies, animal surveys, and vernal pool assessments. Should the Miller Ecological Park conduct ample research, the park will become a model for ecological parks around the state and country.

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## Appendix

**Table 1**
*Contact and Website Information*

<b>Section</b>	<b>Product/Service</b>	<b>Name</b>	<b>Contact</b>
<b>A</b>	<b>Volunteers</b>	<b>Dan Beard Council Boy Scouts of America</b>	<b>(513) 577-7700</b>
<b>B</b>	<b>Equipment and Machinery</b>	<b>Sun Belt Rentals</b>	<b>Manager: Ryan Balcom (513) 681-4488 pcm213@sunbeltrentals.com</b>
<b>C</b>	<b>Ohio EPA Grant</b>	<b>Surface Water Improvement Fund</b>	<b>Russ Gibson (614) 644-2020 russ.gibson@epa.ohio.gov Ohio EPA Division of Surface Water P.O. Box 1049 Columbus, OH 43216-1049</b>
<b>D</b>	<b>Ohio EPA Grant</b>	<b>Ohio Environmental Education Fund</b>	<b>Carolyn Watkins (614) 644-2873 oeef@epa.ohio.gov Office of Environmental Education P.O. Box 1049 Columbus, OH 43216-1049</b>
<b>E</b>	<b>National Fish and Wildlife Foundation Grant</b>	<b>Five Star and Urban Waters Restoration Grant Program</b>	<b>Claire Thorp (415) 243-3104 clair.thorp@nfwf.org</b>
<b>F</b>	<b>Wetland Mammals</b>	<b>Wildlife Habitat Management Institute</b>	<b><a href="http://purl.access.gpo.gov/GPO/LPS49552">http://purl.access.gpo.gov/GPO/LPS49552</a></b>
<b>G</b>	<b>Syracuse University Press</b>	<b>A Naturalist's Guide to Wetland Plants: An Ecology for Eastern North America</b>	<b>Must be purchased online or in a book store</b>
<b>H</b>	<b>Ohio EPA</b>	<b>Pesticide Permit Information</b>	<b><a href="http://epa.ohio.gov/dsw/permits/GP_Pesticide.aspx">http://epa.ohio.gov/dsw/permits/GP_Pesticide.aspx</a></b>
<b>I</b>	<b>The International Institute for Wetland Science and Public Policy</b>	<b>Constructing Wetland Boardwalks and Trails</b>	<b><a href="http://aswm.org/pdf_lib/2_boardwalk_6_26_06.pdf">http://aswm.org/pdf_lib/2_boardwalk_6_26_06.pdf</a></b>
<b>J</b>	<b>The Ohio Environmental Council</b>	<b>Vernal Pools</b>	<b><a href="http://www.theoec.org/VernalPools">http://www.theoec.org/VernalPools</a></b>
<b>K</b>	<b>Ohio EPA</b>	<b>Volunteering for Wetlands</b>	<b><a href="http://water.epa.gov/type/wetlands/outreach/upload/volunteer_pr.pdf">http://water.epa.gov/type/wetlands/outreach/upload/volunteer_pr.pdf</a></b>